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FOREWORD

This document is a compendium of references to papers reporting research supported by the NASA Geology Program over the past decade. This Program has been carried out largely by the university community together with NASA research centers, the Jet Propulsion Laboratory and the Goddard Space Flight Center. In addition, there was strong involvement and cooperation with other federal agencies, most notably the U.S. Geological Survey, and other countries. To make an assessment of the scope of this document, a very brief history of the Program should be considered.

NASA's global scale geological studies of the Earth from space started in the 1960's with TIROS images which provided synoptic views of land forms and geologic structures. The Earth-orbiting manned missions were the sources of much of the early satellite data which were acquired using handheld film cameras to study scale features of the coastal zone, deserts, volcanoes, mountain ranges, and other geologic environments.

About 1970, the new NASA Applications Program developed and launched the first Earth Resources Technology Satellite (ERTS). Its primary sensor, the three-band, 79-meter-ground-resolution, Multi-Spectral Scanner (MSS) began acquiring relatively high-resolution spectral data which were used in many disciplines including geology. This series was followed by the Landsat which carried the 30-meter, 7-spectral-band Thematic Mapper (TM).

At this time, the focus of the Geology Program was on the exploitation of satellite remote sensing to assist in mineral and oil exploration. Studies addressed the detection of lineaments, gossans, and geobotanical anomalies as indicators of possible mineral deposits. The study of the structure and formation of geological basins began at this time in conjunction with the search for petroleum deposits.

It was also during this period that the Geology Program supported the development of the Magnetic Field Satellite (Magsat) which was able to chart the Earth's magnetic field from sufficiently low altitude (on an Applications Explorer satellite) to permit detection and mapping of crustal magnetic anomalies. Earlier global magnetic field mapping had been accomplished at lower spatial resolution using magnetometers aboard the Polar Orbiting Geophysical Observatory (POGO) satellite. Magsat not only permitted improved revision of the global magnetic maps which were accepted by international authorities, it also resulted in a very large number of important scientific publications.

In addition, during this period, two instruments were flown on satellites with the objectives of mapping rock types through their thermal infrared (TIR) response. The Surface Composition Mapping Radiometer (launched on a NIMBUS satellite) was designed

to discriminate lithologies on the basis of their TIR spectra while the Heat Capacity Mapping Radiometer (aboard another Applications Explorer) was intended to discriminate them on the basis of their thermal inertia.

In the 1980's the Geology Program began to focus on basic Earth Science questions such as in tectonic, structural geology, and lithologic mapping, and on continuing the study of the formation of sedimentary basins. During this period, attention was drawn to a new generation of sensors. A Synthetic Aperture Radar (SAR) was flown aboard Seasat and acquired a small amount of very interesting data. There were additional short-term flights of SARs aboard the Space Shuttle, notably the flights of SIR-A, -B, and -C. It is expected that such an instrument will be incorporated in the Mission to Planet Earth. Technology development through ground and laboratory studies and through the use of airborne sensors has resulted in the definition of future instruments for the Earth Observing System (EOS). A multispectral TIR imager provided by Japan is scheduled to be launched aboard the EOS platform and a later EOS is supposed to carry the High Resolution Imaging Spectrometer (HIRIS) with 30-meter resolution in 192 spectral bands. Several research activities in the Geology Program are being carried out to test and develop the capability to use data from these instruments.

Currently, the research objectives in the Geology Program are increasingly being addressed to important geological aspects in the context of the Global Change Research Program. In particular, three new areas of interest have been identified: soils (including paleosols, geomorphology, and soils-climate interactions), volcanism-climate interactions, and coastal processes.

Future space missions being developed through the Geology Program include ARISTOTELES which will map the Earth's gravity and magnetic fields and another mission to provide global digital topographic maps.

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